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CBSE

**CENTRAL BOARD SECONDARY
EXAMINATION**

2023

**CLASS
XII**

Questions & Solutions

Date: 16 March 2023 | TIME : (10:30 a.m. to 01:30 p.m)

Duration: 3 hr | Max. Marks: 70






SUBJECT: BIOLOGY

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Roll No.

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Candidates must write the Q.P. Code on the title page of the answer-book

BIOLOGY

Time Allowed : 3 Hours

Maximum Marks : 70

Note :

- (i) Please check that this question paper contains 23 printed pages.
- (ii) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- (iii) Please check that this question paper contains 33 questions.
- (iv) Please write down the serial number of the question in the answer book before attempting it.
- (v) 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

SECTION - A

1. Select the pathogen mismatched with the symptoms of disease caused by it from the list given below : 1
- (a) Entamoeba histolytica : Constipation, abdominal pain.
 - (b) Epidermophyton: Dry scaly lesions on nail.
 - (c) Wuchereria bancrofti : Chronic inflammation of lymphatic vessels of lower limb.
 - (d) Haemophilus influenzae : Blockage of the intestinal passage.

Sol. (d) Human health and disease page no. 147-149

2. Important attributes belonging to a population but not to an individual are: 1
- (i) Birth rate and death rate (ii) Male and female
 - (iii) Birth and death (iv) Sex-ratio
- Select the correct option from the given options :

(a) (i) only (b) (ii) only (c) (ii) and (iii) (d) (i) and (iv)

Sol. (d) Organism and Population page no. 228

3. Many copepods live on the body surface of marine fish. This relationship is an example of: 1
- (a) Commensalism- (b) Parasitism (c) Amensalism (d) Mutualism

Sol. (b) Organism and Population page no. 236-237

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4. Given below is the restriction site of a restriction endonuclease Pst-I and the cleavage sites on a D-A molecule. 1

5' C-T-G-C-A ↓ G3'

3' G ↑ A-C-G-T-C5'

Choose the option that gives the correct resultant fragments by the action of the enzyme Pst-I

- (a) 5' C - T - G C - A - G 3'
3' G - A - C - G - T C 5'
- (b) 5' C - T G - C - A - G 3'
3' G - A - G - C T - C 5'
- (c) 5' C - T - G - C A - G 3'
3' G - A - C - G T - C 5'
- (d) 5' C - T - G - C - A G 3'
3' G A - C - G - T - C 5'

Sol. (d) Biotechnology principles and processes page no. 196

5. Given below is a sequence of bases in mRNA of a bacterial cell Identify the amino acid that would be incorporated at codon position 3 and codon position 5 during the process of its translation. 1

3' AUCAGGUUUGUGAUGGUACGA 5'

- (a) Phenylalanine, Methionine (b) Cysteine, Glycine
(c) Alanine, Proline (d) Serine, Valine

Sol. (a) (hint)

Table 6.1: The Codons for the Various Amino Acids

First position	Second position				Third position
	U	C	A	G	
U	UUU Phe UUC Phe UUA Leu UUG Leu	UCU Ser UCC Ser UCA Ser UCG Ser	UAU Tyr UAC Tyr UAA Stop UAG Stop	UGU Cys UGC Cys UGA Stop UGG Trp	U C A G
C	CUU Leu CUC Leu CUA Leu CUG Leu	CCU Pro CCC Pro CCA Pro CCG Pro	CAU His CAC His CAA Gln CAG Gln	CGU Arg CGC Arg CGA Arg CGG Arg	U C A G
A	AUU Ile AUC Ile AUA Ile AUG Met	ACU Thr ACC Thr ACA Thr ACG Thr	AAU Asn AAC Asn AAA Lys AAG Lys	AGU Ser AGC Ser AGA Arg AGG Arg	U C A G
G	GUU Val GUC Val GUA Val GUG Val	GCU Ala GCC Ala GCA Ala GCG Ala	GAU Asp GAC Asp GAA Glu GAG Glu	GGU Gly GGC Gly GGA Gly GGG Gly	U C A G

[Table 6.1 codon table, page no. 112, Chapter- Molecular basis of inheritance]

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6. Given below are structural details of a human mammary gland : 1
- (i) The glandular tissue in, the breast has 15-20 clusters of, cells called alveoli.
 (ii) The milk is stored-in the lumen of alveoli
 (iii) The alveoli join to form 'the mammary ducts.
 (iv) Mammary ampulla is connected to lactiferous ducts.
- Choose the option that gives the correct detail of human mammary gland.

(a) (i) and (ii) (b) (ii) and (iii) (c) (ii) and (iv) (d) (i) and (iii)

Sol. A functional mammary gland is characteristic of all female mammals. The mammary glands are paired structures (breasts) that contain glandular tissue and variable amount of fat. The glandular tissue of each breast is divided into 15-20 mammary lobes containing clusters of cells called alveoli. The cells of alveoli secrete milk, which is stored in the cavities (lumens) of alveoli. The alveoli open into mammary tubules. The tubules of each lobe join to form a mammary duct. Several mammary ducts join to form a wider mammary ampulla which is connected to lactiferous duct through which milk is sucked out.

[Paragraph 1st, page no. 47, Chapter- Human reproduction]

7. Given below are the list of the commercially important products and their source organisms. Select the option that gives the correct matches. 1

List-I		List-II	
S.No	Bioactive products	S.No.	Microbes(Source organism)
(A)	Cyclosporin A	(i)	<u>Streptococcus</u>
(B)	Statins	(ii)	<u>Trichoderma polysporum</u>
(C)	Streptokinase	(iii)	<u>Penicillium notatum</u>
(D)	Penicillin	(iv)	<u>Monascus purpureus</u>

Options:

- (a) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
 (b) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
 (c) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)
 (d) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)

Sol. Alexander Fleming while working on Staphylococci bacteria, once observed a mould growing in one of his unwashed culture plates around which Staphylococci could not grow. He found out that it was due to a chemical produced by the mould and he named it Penicillin after the mould Penicillium notatum.

Streptokinase produced by the bacterium Streptococcus and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack. Another bioactive molecule, cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus Trichoderma polysporum. Statins produced by the yeast Monascus purpureus have been commercialised as blood-cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

[Page no. 182(last paragraph), 183(10.2.3); Chapter- Microbes in human welfare]

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8. Tetanus antitoxin (Tetanus toxoid) when injected into the human body it immediately provides: **1**
 (a) Innate immunity (c) Auto immunity
 (b) Passive immunity (d) Active immunity

Sol. If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, we need to directly inject the preformed antibodies, or antitoxin (a preparation containing antibodies to the toxin). Even in cases of snakebites, the injection which is given to the patients, contain preformed antibodies against the snake venom. This type of immunisation is called passive immunisation.

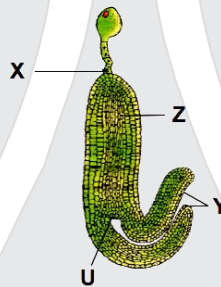
[last but one Paragraph, page no. 152, Chapter- Human Health and diseases]

9. The primary productivity in an ecosystem is expressed as : **1**
 (a) $gm^{-2} y^{-1}$ (b) $gm^{-2} yr$
 (c) $K cal m^{-2} yr^{-1}$ (d) $K cal m^{-2}$

Sol. The rate of biomass production is called productivity. It is expressed in terms of $gm^{-2} yr^{-1}$ or $(kcal m^{-2} yr^{-1})$ to compare the productivity of different ecosystems.

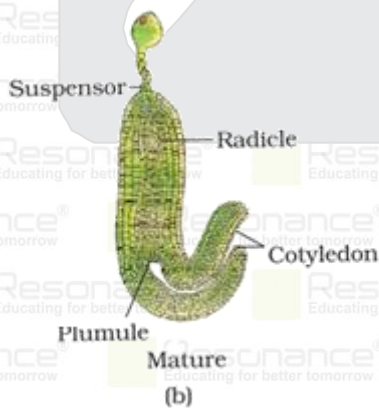
[Paragraph 14.2, page no. 243, Productivity Chapter- Ecosystem]

10. Select the option that shows the correctly identified 'U', 'X', 'Y' and 'Z' in a developing dicot embryo.



- (a) X – Plumule (2n), Y – Suspensor (n), Z – Cotyledon (2n), U – Radicle
 (b) X - Plumule (2n), Y - Suspensor (2n), Z - Radicle (2n), U – Cotyledon (2n).
 (c) X - Suspensor (2n), Y - Cotyledon (2n), Z - Radicle (2n), U - Plumule.
 (d) X - Cotyledon (2n), Y - Radicle (n), Z - Plumule (n), U - Suspensor (n).

Sol. (C)



[Paragraph 2.3, page no. 34, Double fertilization Chapter- Sexual reproduction in flowering plant]

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11. The sixth extinction in progress currently is different from all previous extinctions on earth as it is : 1
 (a) 10-100 times faster (b) 100-1000 times faster
 (c) 100-10000 times faster. (d) 1000-10000 times faster

Sol. The current species extinction rates are estimated to be 100 to 1,000 times faster than in the pre-human times and our activities are responsible for the faster rates. Ecologists warn that if the present trends continue, nearly half of all the species on earth might be wiped out within the next 100 years.
[Paragraph 15.1.4, page no. 264, Loss of biodiversity Chapter- biodiversity and conservation]

12. At which stage during evolution did human use hides to protect their bodies and buried their dead ? 1
 (a) Homo habilis (b) Neanderthal man
 (c) Java man. (d) Homo erectus

Sol. (b)
[Page no 141 Chapter evolution]

Question Nos. 13 to 16 consists of two statements Assertion (A) and Reason

(R). Answer these questions selecting the appropriate option given below:

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
 (b) Both (A) and (R) are true, but (R) is not the correct explanation of (A).
 (c) (A) is true, but (R) is false.
 (d) (A) is false, but (R) is true.

13. **Assertion (A) :** Decomposition process is slower if detritus is rich in lignin and cutin. 1
Reason (R) : Decomposition is largely an oxygen requiring process.

Sol. Decomposition is largely an oxygen-requiring process. The rate of decomposition is controlled by chemical composition of detritus and climatic factors. In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.

[Paragraph 14.3, page no. 244, Decomposition Chapter- Ecosystem]

14. **Assertion (A) :** Determining the sex of an unborn child followed by MTP is an illegal practice. 1
Reason (R) : Amniocentesis is a practice to test the presence of genetic disorders also.

Sol. Another dangerous trend is the misuse of amniocentesis to determine the sex of the unborn child.

15. **Assertion (A) :** In Thalassaemia an abnormal myoglobin chain is synthesized due to a gene defect. 1
Reason (R) : α Thalassaemia is controlled by genes HBA1 and HBA2 on chromosome 16.

Sol. Principles of inheritance Ch. 5, para – 5.8.2 Page No. 91 (Thalassaemia)

Thalassaemia : This is also an autosome-linked recessive blood disease transmitted from parents to the offspring when both the partners are unaffected carrier for the gene (or heterozygous). The defect could be due to either mutation or deletion which ultimately results in reduced rate of synthesis of one of the globin chains (α and β chains) that make up haemoglobin. This causes the formation of abnormal haemoglobin molecules resulting into anaemia which is characteristic of the disease.

Thalassaemia can be classified according to which chain of the haemoglobin molecule is affected. In α Thalassaemia, production of α globin chain is affected while in β Thalassaemia, production of β globin chain is affected. Thalassaemia differs from sickle-cell anaemia in that the former is a quantitative problem of synthesising too few globin molecules while the latter is a qualitative problem of synthesising an incorrectly functioning globin

(a) α Thalassaemia is controlled by two closely linked genes HBA1 and HBA2 on chromosome 16 of each parent. The more genes affected, the less alpha globin molecules produced. While β Thalassaemia is controlled by a single gene HBB on chromosome 11 of each parent and occurs due to mutation of one or both the genes.

(b) α Thalassaemia is controlled by two closely linked genes HBA1 and HBA2 on chromosome 16 of each parent.

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16. **Assertion (A)** : Synthetic oligonucleotide polymers are used during Annealing in a PCR. **1**

Reason (R) : The primers bind to the double stranded DNA at their complementary regions.

Sol. BIOTECHNOLOGY-PRINCIPLES-AND-PROCESSES Ch. 11, para – 11.3.3 Page No. 203 (PCR)

(a) Two sets of primers (small chemically synthesised oligonucleotides).

(b) complementary to the regions of DNA) and the enzyme DNA polymerase.

SECTION - B

17. (a) Name ,(i) a GM cereal crop having enhanced nutritional value, (ii) the nutrient it is rich in.

(b) State any two benefits of Genetically modified crops.

2

Sol. BIOTECHNOLOGY- -AND-ITS-APPLICATIONS Ch. 121, para – 12.1 Page No. 208 (GMO)

Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called **Genetically Modified Organisms (GMO)**. GM plants have been useful in many ways. Genetic modification has:

(a) (i) golden rice.

(ii) Vitamin 'A' enriched rice.

(b)(i) made crops more tolerant to abiotic stresses (cold, drought, salt, heat).

(iv) increased efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil).

18. By using Punnett square depict the genotypes and phenotypes of test crosses (where green pod colour

(G) is dominant over yellow pod colour (g) in Garden pea with unknown genotype.

2

Sol.

	G	g
g	Gg	gg
g	Gg	gg

Green : Yellow

2 : 2

= 1 : 1

In this example, the unknown genotype is crossed with a homozygous recessive (gg) individual. The dominant allele G represents green pod color, while the recessive allele g represents yellow pod color. The genotypes of the resulting offspring can be read from the boxes in the Punnett square.

The possible genotypes of the offspring are GG and Gg. GG individuals will have green pods, while Gg individuals will also have green pods because the G allele is dominant. Only gg individuals will have yellow pods.

The phenotype ratio of the offspring from this test cross will be 1:1, meaning half of the offspring will have green pods and half will have yellow pods. The genotype ratio will be 1:1, meaning half of the offspring will be homozygous dominant (GG) and half will be heterozygous (Gg)

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19. (a) Certain specific bacterial spores are mixed in water and sprayed over Brassica crop to control butterfly caterpillars. Name this bacterium and its mode of action on the butterfly caterpillars. 2

OR

(b) Immunotherapy these days is one of the most efficient way of treatment of cancer. The therapy involved activates the immune system and destroys the tumour. 2

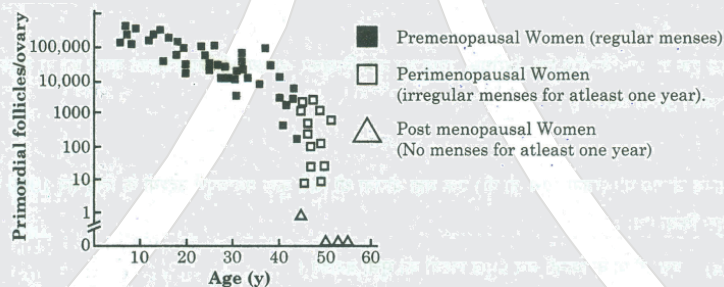
- (i) Write an example of one such biological response modifier used in immunotherapy.
 (ii) Why do patients need such substances if immune system is already working in body?
 (iii) State what is 'Contact inhibition'.

Sol. (a) Bacillus Thurengense formation of inactivation toxin that activates is to insects gut.

(b)

- (i) α - interferon
 (ii) Tumor cells have been shown to avoid detection and destruction by immune system. Therefore, the patients are given substances called biological response modifiers such as α – interferon which activates their immune system and helps in destroying the tumor.
 (iii) In our body, cell growth and differentiation is highly controlled and regulated. In cancer cells, there is breakdown of these regulatory mechanisms. Normal cells show a property called contact inhibition by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells appear to have lost this property.

20. The graph given below shows the number of primordial follicles per ovary in women at different ages. Study the graph and answer the questions that follow. 1 + 1 = 2



(a) What is the average age of the women at the onset of menopause?

(b) At what age are maximum primordial follicles present in the ovary, according to the given graph?

Sol. (a) In human beings, menstrual cycles ceases around 50 years of age; that is termed as menopause.

(b) In human beings, menstrual cycles ceases around 50 years of age; that is termed as menopause.

21. "Some species of insects and frogs have evolved with various specific features that help them from being detected."

(a) Justify the statement giving reasons.

(b) Mention any two such features. 2

Sol. (a) This is the reason why predators in nature are 'prudent'. Prey species have evolved various defenses to lessen the impact of predation.

(b) Some species of insects and frogs are cryptically-coloured (camouflaged) to avoid being detected easily by the predator. Some are poisonous and therefore avoided by the predators.

The Monarch butterfly is highly distasteful to its predator (bird) because of a special chemical present in its body. Interestingly, the butterfly acquires this chemical during its caterpillar stage by feeding on a poisonous weed.

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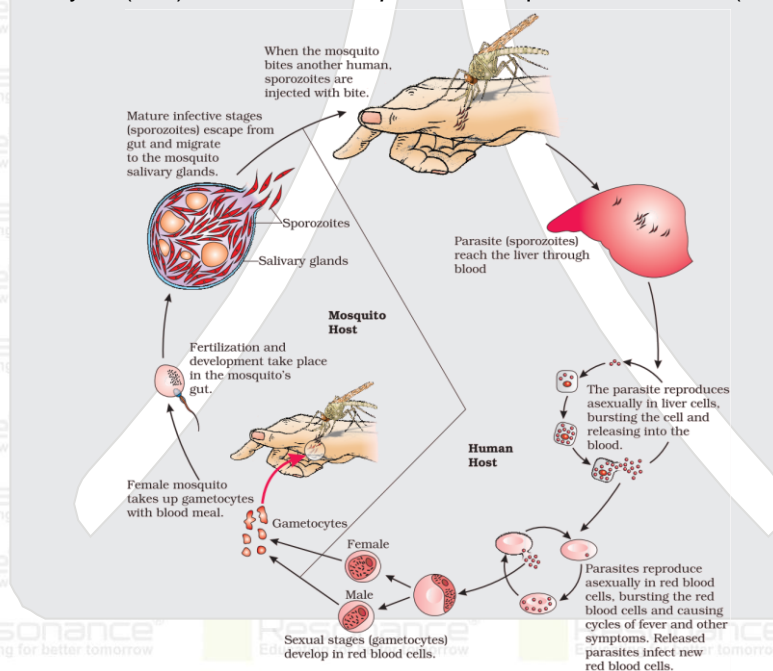
SECTION - C

22. (a) "Plasmodium protozoan needs both a mosquito and a human host for its continuity." Explain. **3**
OR

(b) We all must work towards maintaining good health because 'health is wealth'. Enlist any six ways of achieving good health. **3**

Sol. (a) **Human Health and Disease Ch. 8, para – Last para Page No. 147**

Let us take a glance at the life cycle of *Plasmodium*. *Plasmodium* enters the human body as sporozoites (infectious form) through the bite of infected female *Anopheles* mosquito. The parasites initially multiply within the liver cells and then attack the red blood cells (RBCs) resulting in their rupture. The rupture of RBCs is associated with release of a toxic substance, haemozoin, which is responsible for the chill and high fever recurring every three to four days. When a female *Anopheles* mosquito bites an infected person, these parasites enter the mosquito's body and undergo further development. The parasites multiply within them to form sporozoites that are stored in their salivary glands. When these mosquitoes bite a human, the sporozoites are introduced into his/ her body, thereby initiating the events mentioned above. It is interesting to note that the malarial parasite requires two hosts – human and mosquitoes – to complete its life cycle (8.1); the female *Anopheles* mosquito is the vector (transmitting agent) too.



(b) **Human Health and Disease Ch. 8, para – 1, 2 Page No. 146**

When people are healthy, they are more efficient at work. This increases productivity and brings economic prosperity. Health also increases longevity of people and reduces infant and maternal mortality. Balanced diet, personal hygiene and regular exercise are very important to maintain good health. Yoga has been practised since time immemorial to achieve physical and mental health. Awareness about diseases and their effect on different bodily functions, vaccination (immunisation) against infectious diseases, proper disposal of wastes, control of vectors and maintenance of hygiene in food and water resources are necessary for achieving good health.

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23. "Biodiversity plays a major role in many ecosystem service that nature provides."

(a) Describe any two broadly utilitarian arguments to justify the given statements.

(b) State one ethical reason of conserving biodiversity.

3

Sol. (a) **BIODIVERSITY-AND-CONSERVATION Ch. 15, para – Last para Page No. 265 and 1st para of 266**

The broadly utilitarian argument says that biodiversity plays a major role in many ecosystem services that nature provides. The fast- dwindling Amazon forest is estimated to produce, through photosynthesis, 20 per cent of the total oxygen in the earth's atmosphere.

Pollination (without which plants cannot give us fruits or seeds) is another service, ecosystems provide through pollinators layer – bees, bumblebees, birds and bats. There are other intangible benefits.

(b) **BIODIVERSITY-AND-CONSERVATION Ch. 15, para –2nd para of 266**

The ethical argument for conserving biodiversity relates to what we owe to millions of plant, animal and microbe species with whom we share this planet. Philosophically or spiritually, we need to realise that every species has an intrinsic value, even if it may not be of current or any economic value to us. We have a moral duty to care for their well-being and pass on our biological legacy in good order to future generations.

24. Name and explain a surgical contraceptive method that can be adopted by the male partner of couple. 3

Sol. Reproductive Health Ch. 4, para – 1st para Page No. 62

Surgical intervention blocks gamete transport and thereby prevent conception. Sterilisation procedure in the male is called 'vasectomy'. In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum.

25. Human Genome Project (HGP) was a mega project launched in the year 1990 with some important goals

(a) Enlist any four prime goals of HGP.

(b) Name any one common non-human animal model organism which has also been sequenced thereafter.

3

Sol. (a) MOLECULAR-BASIS-OF-INHERITANCE Ch. 6, para – 2nd para Page No. 118 Goals of HGP

Some of the important goals of HGP were as follows:

(i) Identify all the approximately 20,000-25,000 genes in human DNA;

(ii) Determine the sequences of the 3 billion chemical base pairs that make up human DNA;

(iii) Store this information in databases;

(iv) Improve tools for data analysis;

(b) **MOLECULAR-BASIS-OF-INHERITANCE Ch. 6, para – 1st para Page No. 119**

Many non-human model organisms, such as bacteria, yeast, *Caenorhabditis elegans* (a free living non-pathogenic nematode), *Drosophila* (the fruit fly), plants (rice and *Arabidopsis*), etc., have also been sequenced.

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26. One of the major approaches of crop improvement programme is Artificial Hybridisation. Explain the steps involved in making sure that only the desired pollen grain pollinate the stigma of a bisexual flower by a plant breeder. 3

Sol. SEXUAL-REPRODUCTION-IN-FLOWERING-PLANTS Ch. 2, para – 2nd para Page No. 33

Artificial hybridisation is one of the major approaches of crop improvement programme. In such crossing experiments it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination (from unwanted pollen). This is achieved by emasculation and bagging techniques. If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary. This step is referred to as emasculation. Emasculated flowers have to be covered with a bag of suitable size, generally made up of butter paper, to prevent contamination of its stigma with unwanted pollen. This process is called bagging. When the stigma of bagged flower attains receptivity, mature pollen grains collected from anthers of the male parent are dusted on the stigma, and the flowers are rebagged, and the fruits allowed to develop.

If the female parent produces unisexual flowers, there is no need for emasculation. The female flower buds are bagged before the flowers open. When the stigma becomes receptive, pollination is carried out using the desired pollen and the flower rebagged.

27. Mention Darwin's observations made on finches during his visit to Galapagos Islands. Write the explanation given by Darwin on his observations. 3

Sol. Evolution Ch. 7, Page No. 132 Last and 133 start

During his journey Darwin went to Galapagos Islands. There he observed an amazing diversity of creatures. Of particular interest, small black birds later called Darwin's Finches amazed him. He realised that there were many varieties of finches in the same island.



Variety of beaks of finches that Darwin found in Galapagos Island

All the varieties, he conjectured, evolved on the island itself. From the original seed-eating features, many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches. This process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation. Darwin's finches represent one of the best examples of this phenomenon.

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28. "RNA interference has been used to produce transgenic tobacco plants to protect them from the infestation by specific nematodes." Explain the novel strategy exploited by the biotechnologists. **3**

Sol. BIOTECHNOLOGY-AND-ITS-APPLICATIONS Ch. 12, Page No. 209 Last and and 210 first para.

A novel strategy was adopted to prevent this infestation which was based on the process of RNA interference (RNAi). RNAi takes place in all eukaryotic organisms as a method of cellular defense. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing). The source of this complementary RNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate.

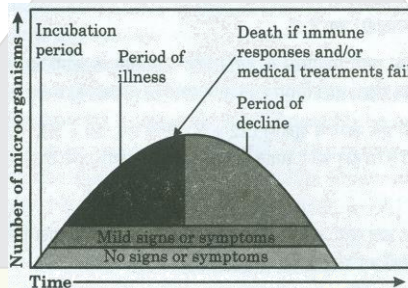
Using Agrobacterium vectors, nematode-specific genes were introduced into the host plant.

The introduction of DNA was such that it produced both sense and anti-sense RNA in the host cells. These two RNA's being complementary to each other formed a double stranded (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of the nematode. The consequence was that the parasite could not survive in a transgenic host expressing specific interfering RNA. The transgenic plant therefore got itself protected from the parasite.

SECTION - D

Q. Nos: 29 and 30 are case based questions. Each question has subparts with internal choice one subpart.

29. When a microorganism invades a host; a definite sequence of events usually occur leading to infection and disease, causing suffering to the host. This process is called pathogenesis. Once a microorganism overcomes the defense system of the host, development of the disease follows a certain sequence of events as shown in the graph. Study the graph given below for the sequence of events leading to appearance of a disease and answer the questions that follow:



(a) in which period, according to the graph, there are maximum chances of a person transmitting a disease infection and why? **1**

(b) Study the graph and write what is an incubation period. Name a sexually transmitted disease that can be easily transmitted during this period. Name the specific type of lymphocytes that are attacked by the pathogen of this disease. **2**

OR

(b) Draw a schematic labelled diagram of an antibody. **2**

(c) In which period, the number of immune cells forming- antibodies will be the highest in a person suffering from pneumonia? **1**

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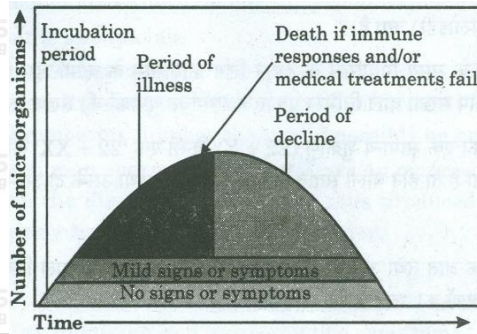
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Name the immune cells that produce antibodies.

HUMAN-HEALTH-AND-DISEASE Ch. 8.



(a) Maximum chances of a person transmitting a disease/infection – Period of illness.

Because of maximum number of micro-organism

(b)

• The incubation period is the time it takes for an infection to develop after a person has been exposed to a disease-causing organism.

- STD – AIDS
- Helper T-Cells

OR

Sol.

(b)

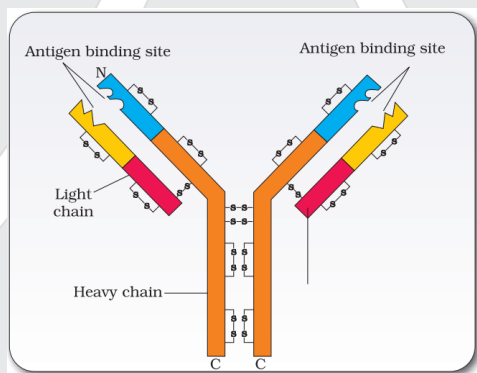


Figure 8.4 Structure of an antibody molecule

[CH-HUMAN-HEALTH-AND-DISEASE Page no 151]

Sol.

(c)

- Number of immune cells are highest – Period of decline.
- B-lymphocytes

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30. The chromosome number is fixed for all normal organisms leading to species specification whereas any abnormality in the chromosome number of an organism results into abnormal individuals. For example, in humans 46 is the fixed number of chromosomes both in male and female. In male it is '44 + XY' and in female it is '44 + XX'. Thus the human male is heterogametic, in other words produces two different types of gametes one with '22 + X' chromosomes and the other with '22 + Y' chromosomes respectively. Human female, on the other hand is homogametic i.e. produces only one type of gamete with '22 + X' chromosomes only.

Sometimes an error may occur during meiosis of cell cycle, where the sister chromatids fail to segregate called nondisjunction, leading to the production of abnormal gametes with altered chromosome number. On fertilisation such gametes develop into abnormal individuals.

(a) State what is aneuploidy. 1

(b) If during spermatogenesis, the chromatids of sex chromosomes fail to segregate during meiosis, write only the different types of gametes with altered chromosome number that could possibly be produced. 1

(c) A normal human sperm (22 + Y) fertilises an ovum with karyotype '22 + XX'. Name the disorder the offspring thus produced would suffer from and write any two symptoms of the disorder. 2

OR

(c) Name a best known and most common autosomal aneuploidy abnormality in human and write any two symptoms.

Sol. (a) Aneuploidy : - 4th para, page no - 91 , Ch - 5, 12th NCERT

Failure of segregation of chromatids during cell division cycle results in the gain or loss of a chromosome(s), called aneuploidy. For example, Down's syndrome results in the gain of extra copy of chromosome 21. Similarly, Turner's syndrome results due to loss of an X chromosome in human females.

Failure of cytokinesis after telophase stage of cell division results in an increase in a whole set of chromosomes in an organism and, this phenomenon is known as polyploidy. This condition is often seen in plants.

(b) Klinefelter's syndrome , Turner's Syndrome : 3rd para, page no 92, Ch - 5 , 12th NCERT

Klinefelter's Syndrome : This genetic disorder is also caused due to the presence of an additional (a)

(c) Aneuploidy example : Down syndrome , 2nd para, Page no - 92, Ch - 5, 12th NCERT

Down's Syndrome : The cause of this genetic disorder is the presence of an additional copy of the chromosome number 21 (trisomy of 21). This disorder was first described by Langdon Down (1866).






The affected individual is short statured with small round head, furrowed tongue and partially open mouth. Palm is broad with characteristic palm crease. Physical, ychomotor and mental development is retarded.

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SECTION – E

31. (a) (i) How and why is charging of tRNA essential in the process of translation?
 (ii) State the function of ribosome as a catalyst in bacteria during the process of translation.
 (iii) Explain the process of binding of ribosomal units to mRNA during protein synthesis. **5**

OR

- (b) Describe the dihybrid cross upto F₂ generation as conducted by Gregor Mendel using pure lines of Garden Pea for characters seed shape and seed colour. **5**

Sol. (a)

(i) Charging of t RNA : Last para , ch - 6, page no - 114, 12th NCERT

6.7 TRANSLATION : Translation refers to the process of polymerisation of amino acids to form a polypeptide. The order and sequence of amino acids are defined by the sequence of bases in the mRNA. The amino acids are joined by a bond which is known as a peptide bond. Formation of a peptide bond requires energy. Therefore, in the first phase itself amino acids are activated in the presence of ATP and linked to their cognate tRNA – a process commonly called as charging of tRNA or aminoacylation of tRNA to be more specific. If two such charged tRNAs are brought close enough, the formation of peptide bond between them

(ii) Function of ribosome as catalyst : 2nd para ,last line page no 115, ch -6, 12th NCERT

The cellular factory responsible for synthesising proteins is the ribosome. The ribosome consists of structural RNAs and about 80 different proteins. In its inactive state, it exists as two subunits; a large subunit and a small subunit. When the small subunit encounters an mRNA, the process of translation of the mRNA to protein begins. There are two sites in the large subunit, for subsequent amino acids to bind to and thus, be close enough to each other for the formation of a peptide bond. The ribosome also acts as a catalyst (23S rRNA in bacteria is the enzyme- ribozyme) for the formation of peptide bond

(iii) Binding of ribosome to mRNA : 4 para , 1st line , page no - 115, ch - 6 , 12th NCERT

For initiation, the ribosome binds to the mRNA at the start codon (AUG) that is recognised only by the initiator tRNA. The ribosome proceeds to the elongation phase of protein synthesis. During this stage, complexes composed of an amino acid linked to tRNA, sequentially bind to the appropriate codon in mRNA by forming complementary base pairs with the tRNA anticodon. The ribosome moves from codon to codon along the mRNA. Amino acids are added one by one, translated into Polypeptide sequences dictated by DNA and represented by mRNA. At the end, a release factor binds to the stop codon, terminating translation and releasing the complete polypeptide from the ribosome.

(b)

DIHYBRID CROSS : page no - 78 , 79 , ch no - 5, 12th NCERT

INHERITANCE OF TWO GENES : Mendel also worked with and crossed pea plants that differed in two characters, as is seen in the cross between a pea plant that has seeds with yellow colour and round shape and one that had seeds of green colour and wrinkled shape. Mendel found that the seeds resulting from the crossing of the parents, had yellow coloured and round shaped seeds. Here can you tell which of the characters in the pairs yellow/ green colour and round/wrinkled shape was dominant? Thus, yellow colour was dominant over green and round shape dominant over wrinkled. These results were identical to those that he got when he made separate monohybrid crosses between yellow and green seeded plants and between round and wrinkled seeded plants. Let us use the genotypic symbols Y for dominant yellow seed colour and y for recessive green seed colour, R for round shaped seeds and r for wrinkled seed shape. The genotype of the parents can then be written as RRYy and rryy. The cross between the two plants can be written down as in showing the genotypes of the parent plants. The gametes RY and ry unite on fertilisation to produce the F₁ hybrid RrYy. When Mendel self hybridised the F₁ plants he found that 3/4th of F₂ plants had yellow seeds and 1/4th had green. The yellow and green colour segregated in a 3:1 ratio. Round and wrinkled seed shape also segregated in a 3:1 ratio; just like in a monohybrid cross.

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32. (a) Bioreactors are the containment vehicles of any biotechnology-based production process. For large scale production and for economic reasons the final success of biotechnological process depends on the efficiency of the bioreactor. 5

Answer the following questions w.r.t. the given paragraph:

- (i) List the operational guidelines that must be adhered to so as to achieve optimisation of the bioreactor system. Enlist any four.
 (ii) Mention the phase of the growth we refer to in the statement "Optimisation of growth and metabolic activity of the cells".
 (iii) Is the biological product formed in the bioreactor suitable for the intended use immediate? Give reason in support of your answer.

OR

- (b) (i) 'EcoRI' has played very significant role in r-DNA technology. 3
 (I) Explain the convention for naming EcoRI.
 (II) Write the recognition site and the cleavage sites of this restriction endonuclease.
 (ii) What are the protruding and hanging stretches of DNA produced by these restriction enzymes called? Describe their role in formation of r-DNA. 2

Sol. (a)

(i) Guidelines for optimization of bioreactor system : page no - 204, 2nd para, ch - 11, 12th NCERT

Small volume cultures cannot yield appreciable quantities of products. To produce in large quantities, the development of bioreactors, where large volumes (100-1000 litres) of culture can be processed, was required. Thus, bioreactors can be thought of as vessels in which raw materials are biologically converted into specific products, individual enzymes, etc., using microbial plant, animal or human cells. A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen).

(ii) (page no 203, last para,) (page no - 204, 1st - para,) ch - 11, 12th NCERT

The cells can also be multiplied in a continuous culture system wherein the used medium is drained out from one side while fresh medium is added from the other to maintain the cells in their physiologically most active log/exponential phase. This type of culturing method produces a larger biomass leading to higher yields of desired protein.

(iii) NO because the biological product formed has to go through down stream process : page no 204, 2nd para, ch - 11, 12th NCERT

11.3.6 Downstream Processing : After completion of the biosynthetic stage, the product has to be subjected through a series of processes before it is ready for marketing as a finished product. The processes include separation and purification, which are collectively referred to as downstream processing. The product has to be formulated with suitable preservatives. Such formulation has to undergo thorough clinical trials as in case of drugs. Strict quality control testing for each product is also required. The downstream processing and quality control testing vary from product to product. (b)

(i) ECoRI : (i) conventional name : page - 195, last para, ch - 11, 12th NCERT

The convention for naming these enzymes is the first letter of the name comes from the genus and the second two letters come from the species of the prokaryotic cell from which they were isolated, e.g., EcoRI comes from Escherichia coli RY 13. In EcoRI, the letter 'R' is derived from the name of strain. Roman numbers following the names indicate the order in which the enzymes were isolated from that strain of bacteria.

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(ii) recognition site : page no - 199 , 3rd para , 12th NCERT, ch - 11

Cloning sites: In order to link the alien DNA, the vector needs to have very few, preferably single, recognition sites for the commonly used restriction enzymes. Presence of more than one recognition sites within the vector will generate several fragments, which will complicate the gene cloning. The ligation of alien DNA is carried out at a restriction site present in one of the two antibiotic resistance genes. For example, you can ligate a foreign DNA at the BamH I site of tetracycline resistance gene in the vector pBR322. The recombinant plasmids will lose tetracycline resistance due to insertion of foreign DNA but can still be selected out from non-recombinant ones by plating the transformants on tetracycline containing medium. The transformants growing on ampicillin containing medium are then transferred on a medium containing tetracycline. The recombinants will grow in ampicillin containing medium but not on that containing tetracycline. But, non-recombinants will grow on the medium containing both the antibiotics. In this case, one antibiotic resistance gene helps in selecting the transformants, whereas the other antibiotic resistance

(ii) Page no 197, para (2nd , 3rd , 4th) ch - 11, 12th NCERT

Restriction enzymes cut the strand of DNA a little away from the centre of the palindrome sites, but between the same two bases on the opposite strands. This leaves single stranded portions at the ends. There are overhanging stretches called sticky ends on each strand. These are named so because they form hydrogen bonds with their complementary cut counterparts. This stickiness of the ends facilitates the action of the enzyme DNA ligase. Restriction endonucleases are used in genetic engineering to form 'recombinant' molecules of DNA, which are composed of DNA from different sources/genomes. When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends' and, these can be joined together (end-to-end) using DNA ligases.

33. (a) (i) Explain the monosporic development of embryo sac in the ovule of an angiosperm. **3**
(ii) Draw a diagram of the mature embryo sac of an angiospermic ovule and label any four parts in it. **2**

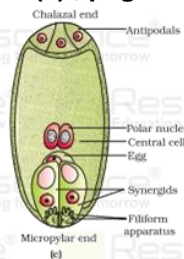
OR

- (i) Explain the formation of placenta after the implantation in a human female. **3**
(ii) Draw a diagram showing human foetus within the uterus and label any four parts in it. **2**

Sol. (i) Monosporic development of ovule : last para page no 26 , ch 2 , 12th NCERT

Female gametophyte : In a majority of flowering plants, one of the megaspores is functional while the other three degenerate. Only the functional megaspore develops into the female gametophyte (embryo sac). This method of embryo sac formation from a single megaspore is termed monosporic development. What will be the ploidy of the cells of the nucellus, MMC, the functional megaspore and female gametophyte?

(ii) diagram of mature embryosac : 2.8 (c) , page no 26 , ch 2 , 12th NCERT



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(i) Placenta formation : 2nd para , page no 53, ch - 3, 12th NCERT

After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body called placenta

(ii) Diagram of human foetus within uterus: 3.12 page 53 , ch - 3 , 12th NCERT

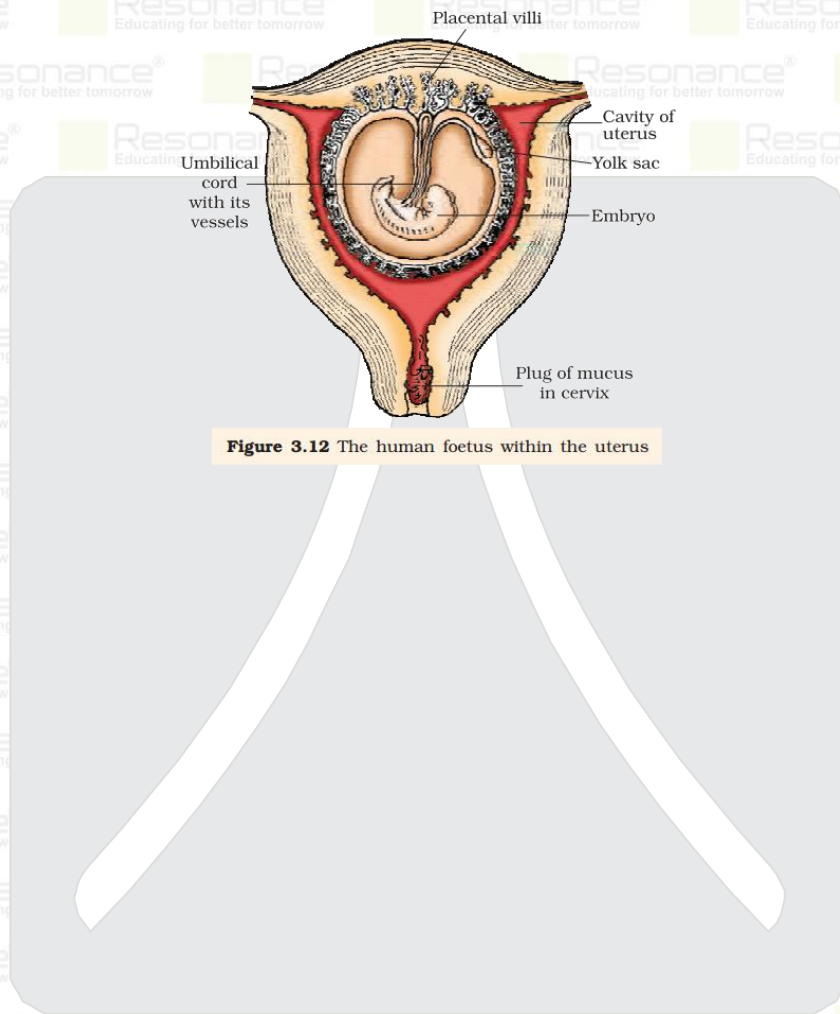


Figure 3.12 The human foetus within the uterus

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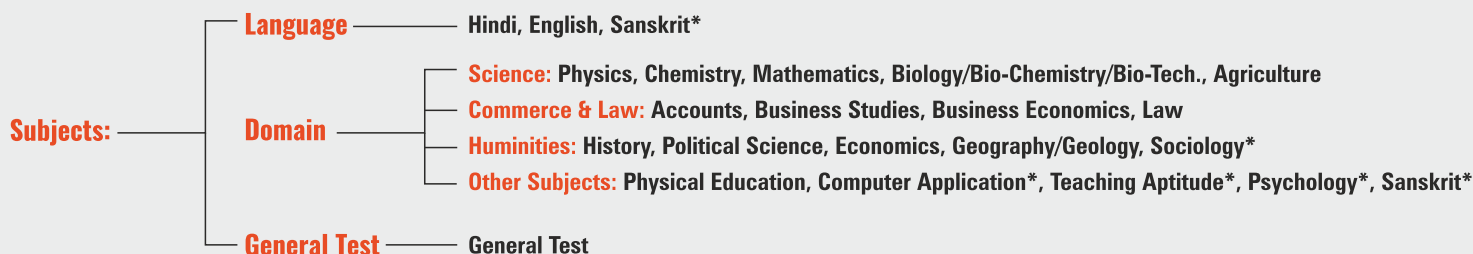
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